

# Toward a Model for Fisheries Social Impact Assessment

RICHARD B. POLLNAC, SUSAN ABBOTT-JAMIESON, COURTLAND SMITH,  
MARC L. MILLER, PATRICIA M. CLAY, and BRYAN OLES

## Introduction

For many years experienced fisheries social scientists have discussed developing a fisheries model for social impact assessment (SIA) that would be more compatible with the approaches taken by fisheries biologists and economists when assessing potential effects of management actions. They suspected that fishery management council (FMC) members might see social impact as-

sessments as more useful if those assessments were provided in a format analogous to fisheries economists' and fisheries biologists' formats.

This point was given further support by Sharp and Lach's (2003) survey of Federal and state fishery managers and decision makers in the Pacific Northwest. They were asked about their knowledge of how to incorporate the social values of fishing communities into planning and decision-making. The authors concluded that it is unlikely that community information can be used in fishery plan development or amendment processes when it is presented in a qualitative, descriptive format.

Stimulated by this discussion, the Office of Science and Technology of NOAA's National Marine Fisheries Service invited a group of marine fisheries social scientists with expertise in social science modeling, quantitative methods, and marine fisheries impact assessment to create a conceptual model for predicting the social impacts of fishery management action alternatives using a limited set of quantitative and qualitative indicators. The resulting model was to be suitable for social impact assessment, and it was to include a dependent measure or output that would be analogous to the

economists' use of jobs, income, or total economic output in their models.

This paper presents the results of the first phase of this group's work. Well-being was selected as the dependent measure for marine fisheries social impact assessment in this model. While this model is not the only possible approach to social impact assessment, it does open a door to a room that is closer to those currently occupied by marine fisheries economists and their biologist counterparts.

## Historical Background

Social impact assessment began as a field in the 1960's as people became more concerned with human impacts on the environment (Finsterbusch and Freudenberg, 2002:408). The National Environmental Policy Act (NEPA) of 1969<sup>1</sup> called for analyzing the impact of human actions on the environment when designated changes were contemplated. Early NEPA guidelines emphasized environmental assessment and did not require SIA's. Few government agencies had yet invested in the social science expertise to do SIA's. Social scientists, however, continued to perfect SIA methodologies (Shields, 1974; Finsterbusch and Wolf, 1977; Finsterbusch et al., 1983; Burch and DeLuca, 1984; Freudenberg, 1986; Barrow, 1997; Becker 1997; Burdge, 1994, 2004; Vanclay, 2003; Taylor et al., 2004).

Preparation and passage of the Fishery Conservation and Management Act of 1976 (now the Magnuson-Stevens Fishery Conservation and Management Act or MSFCMA, also referred to as the

Richard B. Pollnac is with the Marine Affairs Department, Washburn Hall, University of Rhode Island, Kingston, RI 02881-0817 (e-mail: rpo4903u@postoffice.uri.edu). Susan Abbott-Jamieson is with the National Marine Fisheries Service, NOAA, Office of Science and Technology, 1315 East West Hwy SSMC 3, Silver Spring, MD 20910. Courtland Smith is with the Department of Anthropology, Oregon State University, 238 Waldo Hall, Corvallis, OR 97331-6403. Marc L. Miller is with the School of Marine Affairs, University of Washington, 3707 Brooklyn Ave. NE, Seattle, WA 98105-6715. Patricia M. Clay is with the National Marine Fisheries Service, NOAA, Northeast Fisheries Science Center, Woods Hole, MA, mailing address: NOAA/NMFS/ST5, 1315 East West Hwy, SSMC 3, Silver Spring, MD 20910. Bryan Oles is with IM Systems Group, 7313 Trescott Ave., Takoma Park, MD 20912. Opinions and conclusions expressed or implied are solely those of the authors and do not necessarily reflect the views or policy of the National Marine Fisheries Service, NOAA.

**ABSTRACT**—This paper presents a model for Fisheries Social Impact Assessment (SIA) that lays the groundwork for development of fisheries-focused, quantitative social assessments with a clear conceptual model. The usefulness of current fisheries SIA's has been called into question by some as incompatible with approaches taken by fisheries biologists and economists when assessing potential effects of management actions. Our model's approach is closer to

the economists' and biologists' assessments and is therefore more useful for Fishery Management Council members. The paper was developed by anthropologists initially brought together in 2004 for an SIA Modeling Workshop by the National Marine Fisheries Service, NOAA. Opinions and conclusions expressed or implied are solely those of the authors and do not necessarily reflect the views or policy of the National Marine Fisheries Service, NOAA.

<sup>1</sup>See <http://ceq.eh.doe.gov/nepa/regs/nepa/nepaeqia.htm>, accessed 25 May 2006.

MSA<sup>2</sup>) led to efforts to gather social data and to carry out impact analysis specifically for fisheries (OSU, 1978; Acheson et al., 1980). The National Marine Fisheries Service (NOAA-NMFS, 1994, 2001, 2006), in association with social scientists, has been developing SIA approaches since the 1980's.<sup>3</sup> SIA methods were also being developed in other areas of resource management (Kogut, 1976; USDOT, 1982; Bryan, 1984).<sup>4</sup>

The 1990's brought recognition that progress on environmental problems was neither rapid nor successful in part because social and cultural dimensions of resource management were not being given sufficient emphasis. The U.S. Forest Service gathered social scientists from many agencies to develop common SIA approaches (ICGPSIA, 1994). By 1997, SIA became required in many Federal programs.<sup>5</sup> The Interorganizational Committee on Guidelines and Principles for SIA published revised SIA guidelines and principles in 2003 (ICGPSIA, 2003).

In marine resource management, lack of success with fishery management led to changes in the fishery management process and passage of the Sustainable Fisheries Act (SFA) of 1996. National Standard 8 of the SFA requires explicit consideration and minimization of community impacts. The NMFS (1998) subsequently published National Standard 8 Guidelines<sup>6</sup> and has directed efforts toward community profiling to serve as

an informed basis from which to begin SIA. While economists had been on NMFS staff since its incarnation as the Bureau of Commercial Fisheries in 1956 (Hobart, 1995), and one anthropologist or sociologist had been in Headquarters since 1974, NMFS hired its first regional social scientist (other than economists) in 1992. By 2005, each NMFS region except the Southwest had at least one such social scientist, signaling a new agency effort to develop its capability to meet its obligations to examine sociocultural regulatory impacts (Colburn et al., 2006).

### Objectives

Building on previous government experience and an extensive literature on SIA, our effort takes SIA for marine resource management a step further. Our goals include making SIA more quantitative and useful. First, data derived through SIA should be amenable to comparison across space and time and should be cross-referenced with biophysical and economic data.

Biophysical and economic data are typically more quantitative than the social science data currently collected for SIA. The quantitative natures of biophysical and economic data facilitate the comparison of datasets collected in disparate spatial and temporal frames. To obtain quantitative social science data for comparative purposes that can be linked with biophysical and economic data, variables need to be identified, defined, and operationalized in a consistent way, and sufficient data must be gathered to make comparisons statistically and scientifically defensible. Operationalization means measuring variables in a way that is replicable, reliable, accurate, and valid. It means the measure is comprehensible to all researchers conducting SIA.

The approach presented here emphasizes the fact that humans are an important component of marine ecosystems. NMFS has committed itself to developing ecosystem-based approaches to marine resource management<sup>7</sup> (NMFS, 1999), an approach compatible with the approach presented here. The current NOAA working definition of an

ecosystem is "... a geographically specified system of organisms (including humans), the environment, and the processes that control its dynamics".<sup>8</sup> Another goal is to develop an SIA model that is fully compatible with ecosystem-based approaches to fisheries management.

### Well-Being, the Dependent Measure

The SIA model for marine resource management is designed to predict changes in well-being. Well-being refers to the degree to which an individual, family, or larger social grouping (e.g. firm, community) can be characterized as being healthy (sound and functional), happy, and prosperous.

One might argue that changes in economic welfare, such as changes in income or wealth are adequate measures of well-being. Social scientists, however, have shown that fishing and interaction with marine resources is much more than solely an economic activity (Acheson et al., 1980; Anderson, 1980; Smith, 1981; McCay et al., 1993; Bunce et al., 2000). Well-being is affected by a large number of sociocultural and economic variables that are impacted by management decisions, making it a suitable measure in this context (Colfer and Byron, 2001; Eckersley, et al., 2001; Gullone and Cummins, 2002; Suh and Deiner, 2003). There is a substantial literature on this widely used construct as well as on its operationalization at the individual, community, and national levels of analysis. It has the advantage that it can be measured in multiple ways

<sup>2</sup>See [http://www.nmfs.noaa.gov/sfa/sustainable\\_fisheries\\_act.pdf](http://www.nmfs.noaa.gov/sfa/sustainable_fisheries_act.pdf), accessed 25 May 2006.

<sup>3</sup>An online version for NMFS of the 1994 ICGP-SIA Guidelines and Principles for Social Impact Assessment can be found at [http://www.nmfs.noaa.gov/sfa/social\\_impact\\_guide.htm](http://www.nmfs.noaa.gov/sfa/social_impact_guide.htm), accessed 2 May 2007.

<sup>4</sup>See Bowen, Palmer. 1980. Social impact assessment forest planning and decision making: Technical review draft. USDA, For. Serv., Northern Region, Missoula, Mont., for an additional reference.

<sup>5</sup>See the United States General Services Administration's 1997 Call-in Fact Sheet at [http://www.gsa.ene.com/factsheet/0397/03\\_97\\_9.htm](http://www.gsa.ene.com/factsheet/0397/03_97_9.htm), accessed 12 August 2005. An alternative reference <http://www.epa.gov/superfund/action/guidance/SILitRevFinal.pdf>, accessed 24 July 2006, contains a table comparing actual numbers of SIA's done by agency 1979-1994.

<sup>6</sup>See <http://www.st.nmfs.gov/st1/econ/cia/sia/natstand-final.pdf>, accessed 5 May 2007.

<sup>7</sup>See [http://ecosystems.noaa.gov/whats\\_new.htm](http://ecosystems.noaa.gov/whats_new.htm), accessed 25 May 2006. Current presentations on developing NMFS's ecosystem based management programs are given here.

<sup>8</sup>The parenthetical phrase "including humans" does not appear in the NOAA Fisheries Glossary (Blackhart, et al., 2005) definition of ecosystem (p. 11), however it has been included in the definition at least since 2003 appearing in internal memos from the NMFS Chief Scientist to others outside NMFS, and is part of the definition used in diverse presentations to diverse audiences. This emphasizes that humans are among the organisms whose behavior must be considered when studying marine ecosystems. For example see Stephen Murawski's 19 May 2006 presentation "Ecosystems approaches to management: The EGT's work in progress", online at [http://ecosystems.noaa.gov/whats\\_new.htm](http://ecosystems.noaa.gov/whats_new.htm), accessed 25 May 2006.

using established and publicly available indicators for different levels of analysis (Sharpe, 1999; Ryan and Deci, 2001; Sirgy, 2002; Zumbo, 2002), and it can be related to the narrower economic measures of welfare.

### SIA Procedure

The first step carried out by an analyst in an SIA is a scoping process to determine the sociocultural variables relevant to the management questions (NMFS, 2001). This can lead to initial sketches of the sociocultural system that may be affected by the management action. Management actions will affect a range of social entities including individuals, firms, families, and communities<sup>9</sup>, and therefore the SIA must attend to these as distinct units of analysis.

Special attention should be given to social groups that may gain or lose from the management choices made. These populations may not always be readily visible at public hearings or on newspaper op-ed pages. Scoping, therefore, requires an assessment of each part of the sociocultural system that is likely to be affected, with specific attention to any marginalized populations because environmental justice issues may also be involved.

Of primary concern is measuring how the well-being of system participants will change. The objective is not to include every sociocultural element in the system; it is to do an initial assessment that identifies the critical populations that have a significant stake in the management action and the issues of concern to these populations that may increase or decrease their well-being.

The next step following the scoping process is to operationalize the relevant variables by defining the variables in a way that facilitates measurement.<sup>10</sup>

<sup>9</sup>Communities can be spatial, occupational, interest-based, cultural, or ethnic. With reference to the MSA, communities designated under National Standard 8 must be place-based, but communities based on other criteria may be appropriate for the general social impact assessment required for all communities involved in fishing.

<sup>10</sup>It is important to note here that one of the bases for people's behavior is perception, even though those perceptions sometimes deviate from other empirical measures.

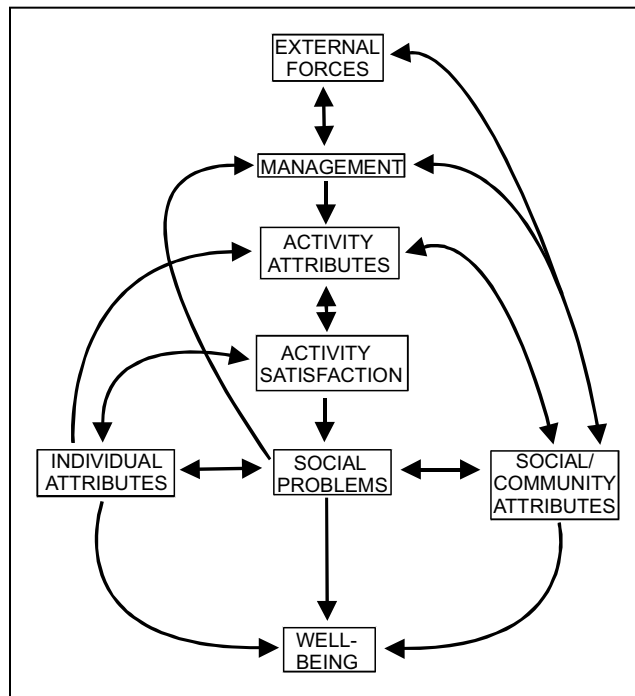


Figure 1.—General marine resource SIA model. Ecosystem does not appear as an element in the model because everything in the diagram is part of the ecosystem. It is incorrect to add ecosystem to external forces, although parts of the ecosystem are “external forces” because the community is also part of the ecosystem.

A variety of instruments available for these assessments are given in the appendix. Limited financial resources, time constraints, and staff skill level might further limit the variables and measures chosen.

More important than simply identifying variables, however, is discerning the relationships among them. This is because the impact on one variable or variable set may be transmitted to another linked variable or variable set through cumulative processes, feedback loops, and other systematic relationships. These relationships can exist both within single levels of analysis (e.g. the community) and across levels of analysis (e.g. the individual, the family, and the community). Some of these relationships are explored in the following sections.

### General Fishery SIA Model

The general marine resource SIA model presented in Figure 1 depicts

the sociocultural system, showing that external forces influence management strategies, which, in turn, influence human activities with regard to marine resources. These changes in activities impact satisfaction with the activities, and this influences aspects of individuals and the communities in which they live, as illustrated by the individual and social attributes (Fig. 1). The arrows in this figure reflect interrelationships (cause-effect, resonance, cumulative impacts) between these classes of variables that will be explained below as the general model is developed for commercial, subsistence, and recreational fisheries.

### SIA in Three Types of Fisheries

Although there are many ways to classify U.S. fisheries, fishery managers identify three categories: commercial, subsistence, and recreational fisheries, and their subtypes. We consider how

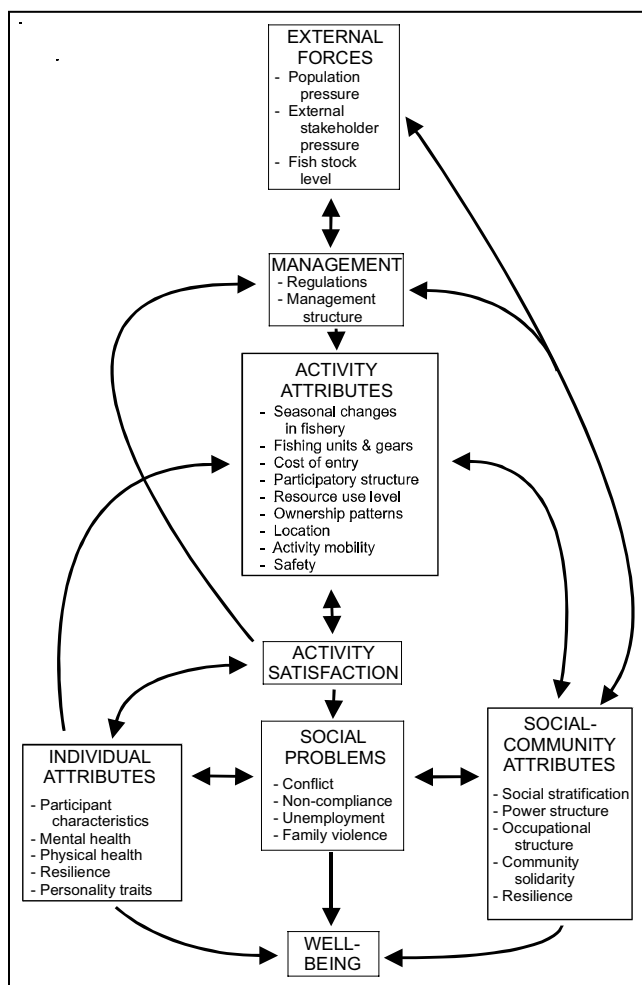


Figure 2.—Simplified fishery SIA model with selected indicators.

SIA can be conducted for each of these three kinds of fisheries. The examples that follow build from descriptions of the general ecosystem and illustrate relationships among variables that impact well-being. In the most general of formulations, a fishery is a system in which humans are linked to “fish.”

### Commercial Fisheries

First, we will examine potential impacts of management on commercial fishermen<sup>11</sup> and shore side entities that constitute the commercial sector (e.g. processors and dealers, ice houses, etc.),

<sup>11</sup>Following the convention of most people who fish, we employ the term “fishermen” to denote both males and females.

as well as the commercial sector of the marine recreational fishery, including charter boat operators, party boat operators, guides, marina operators, bait and tackle dealers, and other entities appropriate to the SIA.

The simplified model (Fig. 1) presents some rather obvious relationships, and Figure 2 identifies for illustrative purposes a few of the specific variables included in each of the general categories in Figure 1. A more comprehensive list of variables can be found in the appendix. We argue that external forces, such as population pressure, declining fish stocks, environmental activism, and climate change influence the management of fisheries. In turn, management, which can impact fishing targets, times,

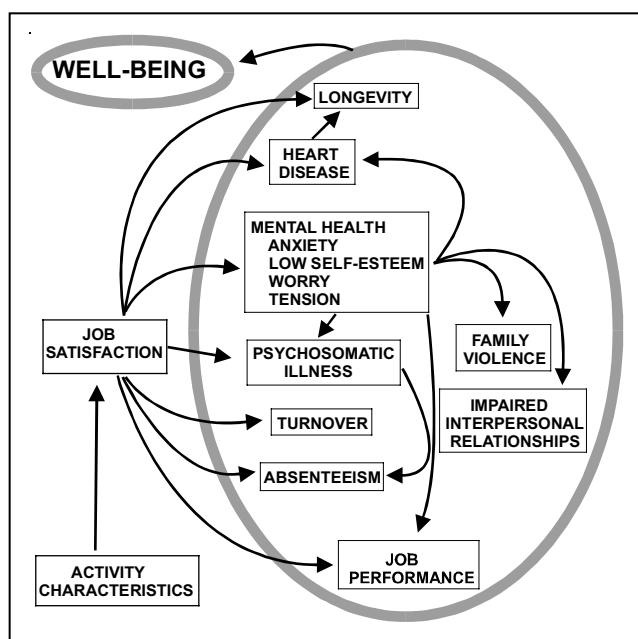


Figure 3.—Impacts of job satisfaction.

techniques, numbers of fishermen, and other variables (the appendix lists activity attributes) has an influence on various attributes of the occupation of fishing.

Impacts of the changes will vary according to attributes of the impacted fishery, fishermen, and community—some are more resilient (see glossary) than others. Smith et al. (2003), for example, discuss some factors influencing differential resilience of fishing families impacted by the Florida net fishing ban, and Gilden et al. (1999) discuss Oregon fishing communities’ differential ability to cope in the face of complex regional changes. Individual and social resilience are complicated variables that represent an ability to cope with change, and they are related to other social and psychological variables including social support systems (both familial and external), self-esteem, and perceived control (Mederer, 1999). Additionally, Mederer (1999) notes that resilience is not a fixed attribute, but results from interaction between family and individual attributes and external circumstances.

Individual fishermen accustomed to a fishery with one set of attributes must then become accustomed to changes, some of which may impact their level

of activity satisfaction and ultimately their well-being. In the instance of an occupation like commercial fishing we will refer to the activity satisfaction of individuals as job satisfaction, which is more commonly used in the literature. A great deal of research (Apostle et al., 1985; Pollnac and Poggie, 1988; Gatewood and McCay, 1990; Binkley, 1995; Pollnac et al., 2001) has linked job satisfaction to 1) individual attributes such as mental health and longevity, and 2) social problems such as family violence, absenteeism, and job performance (Fig. 3 gives a more complete list of impacts<sup>12</sup>).

While job satisfaction is an important aspect of all occupations, it is especially significant with regard to a fishery—including both commercial fishermen and commercial sectors of the recreational fishing industry (e.g. charter boat operators and fishing guides). The structure of job satisfaction among these groups manifests a common component<sup>13</sup> that is not always found in other occupations—a self-actualization component that includes “adventure” and “challenge” (Smith, 1981; Apostle et al., 1985; Pollnac and Poggie, 1988; Gatewood and McCay, 1990; Binkley, 1995; Pollnac, et al., 2001; Pollnac and Poggie, 2006).

These concepts have been described by fishermen as including the thrill of the hunt, the challenge of facing the power and expanse of the sea, and the overall adventure of pitting oneself against the elements and finding fish.

These attitudes towards the occupation of fishing are found in the U.S. east

coast, Canada, Southeast Alaska (see Pollnac and Poggie, 2006), Southeast Asia (Philippines, Vietnam and Indonesia: Pollnac et al., 2001), and Central America (Pollnac and Ruiz-Stout, 1977).

Pollnac and Poggie (1980) suggest that this is an attitude shared by most fishermen. For example, in response to a question asking a sample of fishermen ( $n=153$ ) from 11 villages what they like about fishing in comparison to other occupations, the most frequent response category was “sport-pleasure” (35%) followed by “income” (31%) and “independence” (16%). With regard to the “sport-pleasure” category, fishermen actually said that fishing is like a sport. They emphasized the sporting aspect of struggling with fish as well as the pleasurable aspects of being on the sea and in the fresh air (Pollnac and Ruiz-Stout, 1977).

These components of job satisfaction are related to a personality trait that serves to adapt fishermen to the dangers and risks of their occupation (see Pollnac et al., 1998 and Pollnac and Poggie, 2006 and the references therein). Overall, an extensive literature supports the contention that fishermen manifest the personality traits of being adventurous, active, aggressive, and courageous (Poggie and Gersuny, 1974; Pollnac, 1988; Binkley, 1995).

We are not arguing that it is only these personality traits that result in individuals choosing to become fishermen. They also enter the occupation as a means of making money, because their family or friends are fishermen, and/or because it is a traditional occupation in their community.

What we do argue, however, is that individuals not manifesting these personality traits would not be satisfied with the risks to personal safety and production associated with the dangers, challenges, and uncertainty of the occupation (as illustrated by the arrow from “individual attributes,” which includes personality, to “job satisfaction” in Fig. 2) and would either be less efficient as fishermen or drop out of the occupation entirely (Binkley, 1995; Pollnac et al., 1998). This could then increase the

percentage of fishermen manifesting these traits.

Management measures which influence aspects of fishing (e.g. quotas, time limits, numbers of days fishing available, and a myriad of other constraints on many aspects of the fishing activity), will have differential impacts on job satisfaction, ranging anywhere from negative to positive, depending on the action. Regulations that require fishermen to spend either more or less time than usual at home can impact not just job satisfaction but family life, and both are important components of well-being. Regulations requiring large capital investments can limit investments in other important areas such as vessel maintenance, the fishermen’s homes, and their children’s education—all impacting well-being. Changes that result in the loss of fishing opportunities, however, will have the greatest negative impacts, as alternative income projects are often problematic for this group (Pollnac et al., 2001; Sievanen et al., 2005; Pollnac and Poggie, 2006).

Social problems associated with job dissatisfaction, as well as other variables mentioned above, can impact aspects of community structure including community solidarity and levels of compliance with fishery regulations. In turn, levels of compliance can feed back and impact aspects of fishery management. Further, other aspects of community structure, such as occupational structure, can impact activity attributes. Community power structure, which might include powerful fisheries organizations, can directly influence management as well as the external forces that influence management. Finally, individual attributes, social problems, and community structure all have an effect on well-being.

A familiar example of the relationships between some of the variables in Figure 2 would be the external forces (e.g. industry organizations) that have influenced managers in some areas to implement individual fishery quotas (IFQ’s) (management). In Alaska this was accomplished with the Pacific halibut (*Hippoglossus stenolepis*)/sablefish (*Anoplopoma fimbria*) IFQ program, which eliminated the short “derby

<sup>12</sup>USHEW (1973) gives an important early discussion on heart disease and psychosomatic illness relationships to work. Subsequent research continues to confirm a relationship between aspects of occupation or work conditions and cardiovascular disease as well as other diseases. Faragher et al. (2005) provides a recent meta-analysis of the literature on the relationship between job satisfaction and health including cardiovascular disease, and Heslop et al. (2002) is a longitudinal study of the relationships between job satisfaction, cardiovascular risk factors, and mortality. An extensive literature exists in this area.

<sup>13</sup>Other components found among fishermen, such as “basic needs” like safety, cleanliness, and earnings, are also commonly found associated with other occupations (per references cited in footnote 12).

fishing”<sup>14</sup> seasons, and spread fishing out over a longer period (activity attributes). Interviews conducted as part of a research project in Southeast Alaska in 2002–03 (cf. Pollnac and Poggie, 2006) indicated that in some fisheries in Alaska, the IFQ also led to a decrease in crew size (activity attributes) since there was no longer a need for a large crew to maximize catches in a short period, as there had been during the short pre-IFQ management fishing season. With the catch spread out over a longer period, the seasonal changes in the fishery<sup>15</sup> (activity attributes) were also influenced. Further, with a smaller crew the owner could rely on a few family members, reducing the need to hire nonfamily crew members (activity attribute), and in turn reducing the occupational mobility of those not coming from fishing families (social-community attributes, individual attributes). In addition, the cost of an IFQ became so large (activity attributes) that many young people lost the hope of ever accumulating enough capital to enter the fishery (individual attributes), hence restricting their occupational mobility (social-community attributes). Many former crewmembers were forced to leave the fishery (social-community attributes, social problems); some also lost hope of ever becoming a boat owner (individual attributes), hence impacting fishery employment level (social-community attributes, social problems). Relationships between these variables are shown in Figure 4, which illustrates the impacts of these changes in the occupation on other important variables including well-being.

The changed occupation structure of the impacted communities has resulted in greater social stratification, with relatively well-off IFQ holders (some holding multiple permits) gaining more power in the community and increasing their influence on management, at the

expense of unemployed crew members and those who have been unable to accumulate multiple permits (social-community attributes, social problems). Thus, the well-being of the IFQ holders increased while that of the unemployed former crew decreased.

Fishermen forced out of the industry who have moved into other occupations, as well as those who see no chance to improve their position in the fishery, have decreased job satisfaction with its attendant negative impacts, including decreases in well-being. Those with IFQ’s have increased job satisfaction (individual attributes) and well-being. Hence, well-being has improved for some and decreased for others (cf. Pollnac and Poggie, 2006). Loy (2006) reports on a similar situation developing in a new quota fishery for the Alaskan Bering Sea/Aleutians Islands king and Tanner crab fishery (*Paralithodes camtschaticus*, *P. platypus*, *Lithodes aequispinus*, *L. couesi*, *Chionoecetes bairdi*, *C. opilio*, *C. tanneri*, and *C. angulatus*), which has not only IFQ’s but also individual processing quotas (IPQ’s) for processors. Similar problems associated with IFQ’s in other fisheries have been noted by Childers (2007). Discussion concerning measurement and analyses of these variables is found in the appendix.

### Subsistence Fisheries

Subsistence fishing refers to fishing activity directed at capturing fish for consumption rather than sale. The simplest example would involve a person who captures fish for consumption by his or her nuclear household.<sup>16</sup> More complex examples involve capture and distribution networks of families with no sale involved. For example, Magdanz et al. (2002), conducting research in Wales and Deering, Alaska, using network analyses, identified eight production and distribution networks in Wales and six in Deering. Networks averaged 5 house-

holds (range 2 to 11) and 17 individuals (range 2 to 41).

Further, the simplest cases of subsistence fishing involve production of fish for human food, thus reducing the costs of feeding a family. Sometimes, however, the harvest is used to feed animals essential to subsistence activity. For example, in the Kotzebue District of Alaska, about 9% of the subsistence salmon harvest for 2003 was used to feed sled dogs, which was down from a high of between 29 and 34% in 1995–97 (Georgette et al., 2004).

In more complex but also relatively common cases, especially those involving distribution networks, the producers gain prestige and social security, rather than monetary income, by providing for networks of consumers (Kishigami, 2005; Stewart, 2005), and the act of sharing reinforces intra-group solidarity and cooperation so essential among subsistence peoples (Freeman, 2005; Stewart, 2005). The best producers harvest more than they and their immediate families need, and they share the excess with relatives and other people in the community, contributing to their relative prestige, and perhaps more importantly, to a sense of community and cooperation among the people of the community (Magdanz et al., 2002).

Finally, among some peoples, a subsistence-based lifestyle is an important aspect of cultural identification, and the product itself may form an essential part of specific cultural activities (Norris, 2002). Other than the preceding aspects of subsistence fishing, which are vastly more important in this sector than in commercial fishing (Fig. 2), many of the same issues identified for assessing the commercial fishery apply.

An example will help illustrate some of the relationships between the variables included in Figure 2 as well as the subsistence-specific variables discussed above relating to our model. The Makah Nation members in Washington, like many of the original inhabitants of the northwest coast of North America, have a long tradition of seal (*Callorhinus ursinus*, pre-1900; *Phoca vitulina* and *Zalophus californianus* today<sup>17</sup>) hunting stretching for thousands of years into

<sup>14</sup>Derby fishing is a fishery of brief duration during which fishermen race to take as much catch as they can before the fishery closes. This typically leads to congested fishing grounds and unsafe fishing conditions, as well as lower quality fish and lower prices per pound.

<sup>15</sup>Annual round is another commonly used term for seasonal changes in fishing activity.

<sup>16</sup>In the context of subsistence fishing, “consumption” has two meanings. For some subsistence fishermen, fish provide food (i.e. nourishment in the form of protein and fats) for the body. For others, fish provide food (i.e. spiritual and ritual nourishment) for the soul. Both kinds of subsistence fishing are proper objects of SIA.

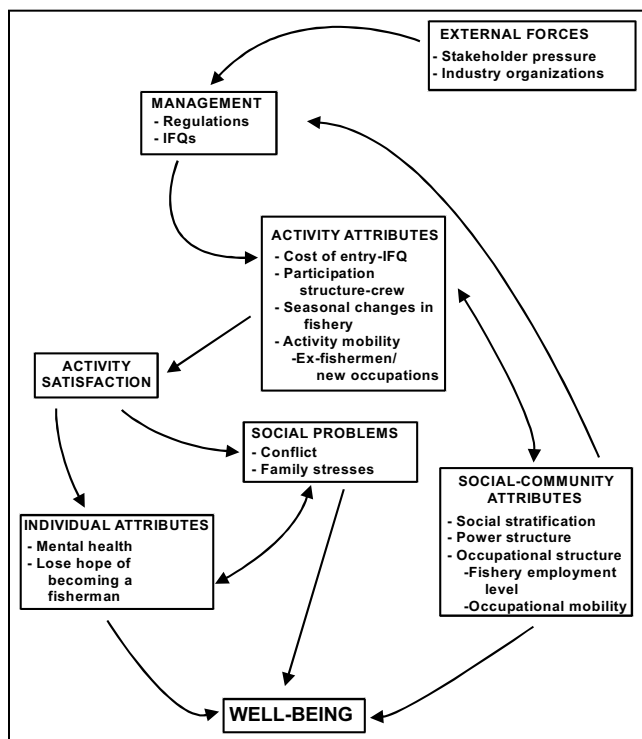


Figure 4.—Model of relationships between external factors, mediating variables, and well-being from the Alaska Pacific halibut and sablefish IFQ programs.

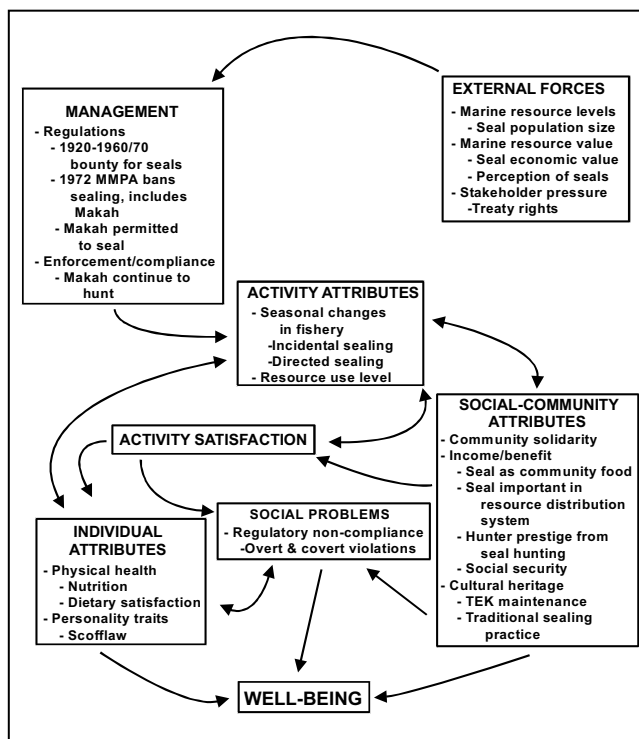


Figure 5.—Model of relationships between external factors, mediating variables, and well-being among the Makah Nation members.

the prehistoric past (Sepez, 2001).<sup>18</sup> Seal products formed a significant and desired part of the diet, and the hunting and distribution of these products were important elements in a communal distribution system, confirming social relationships and bestowing prestige on the hunters.

This tradition and its associated knowledge led the hunters to be hired as crew members on sealing schooners in the late 1860's, eventually purchasing

their own boats and gear in the 1890's. This resulted in a high level of well-being for the Makah.

During the 1890's the United States began regulating sealing through international agreements, and seizures of Makah boats occurred despite the fact that the Treaty of Neah Bay gave the Makah the right to fish, whale, and seal in accustomed grounds, and Makah well-being declined.<sup>19</sup>

The Makah, contending that the treaty gave them the right to hunt, continued sealing, leading to further seizures. This resulted in a generalized distrust of both government resource management and commitment to treaty rights. This brief history provides the background to help explain the social impacts of interrelationships between efforts to manage seal populations and aspects of Makah society and culture in the 20th century.

<sup>17</sup>The Makah's seal hunting has usually encompassed several species at any given time. See J. Sepez, *In press*, Historical Ecology of Makah Subsistence Foraging Patterns, J. Ethnobiol., and M. Etnier and J. Sepez, *In press*, Changing patterns of sea mammal exploitation among the Makah. In D. Papagianni, R. Layton, H. Maschner (Editors), *Time and change: archaeological and anthropological perspectives on the long term in hunter-gatherer societies*, Oxbow Books, Oxford, U.K., for a full discussion of historical and current Makah seal hunting.

<sup>18</sup>For specific references concerning aspects of Makah seal hunting discussed here consult Sepez (2001). We would like to thank the author for her willingness to discuss this section as it was being written and for reviewing the final product.

<sup>19</sup>The assessment of Makah relative well-being is made based on Sepez's (2001) research, and includes personal communication with her specific to this issue.

Figure 5 models the relationships discussed in the following example.

In the first part of the 20th century harbor seals were considered pests by society at large (i.e. not the Makah), in part due to their voracious consumption of other marine life (external forces). From the 1920's up until 1960 in Washington and 1970 in Oregon, bounty programs were implemented by the states (management), and Makah hunters could collect a bounty for each seal as well as keep seal products for consumption. Later perceptions of marine mammals as being in danger of extinction, as well as a developing belief in the larger society that these mammals are somehow special (external forces) led to the passage of the Marine Mammal Protection Act (MMPA) in 1972. This resulted in prohibiting the Makah from harvesting seals for any purpose, including the retention of incidental catch (management).

The Makah, believing that the Treaty of Neah Bay gave them the right to

harvest seals for subsistence, continued to hunt (social problems) resulting in citations and confiscation of the seals (management). Due to these enforcement activities, sealing was reduced (activity attributes), denying hunters a pursuit they enjoyed (activity satisfaction) and one that provided them with food and prestige in the community (social-community attributes).

Seal products thus became scarce in the community distribution system, reducing an important contributor to social solidarity and social security (social-community attribute). The reduced availability of seal products in the community also negatively impacted nutrition and dietary satisfaction (individual attributes). Violations of the ban, however, continued (social problems), both covertly by changing sealing times and locations (activity attributes) and overtly, with seal being consumed at community parties (social problems). These continuing violations contributed to a scofflaw attitude regarding official U.S. Government management efforts (individual attribute, social problem).

Taken together, all these factors contributed to a decreased sense of both individual and social well-being. Reinterpretation of the MMPA in 1994 led to amendments, once again allowing Native American groups to harvest marine mammals as provided in their treaty rights, hence, beginning the process of reducing the negative impacts that occurred as a result of the original act.

### Recreational Fisheries

We turn now to those who fish for other than commercial and subsistence reasons. For convenience, we employ recreational fishing as a cover term to denote leisure-based fishing which includes the most casual forms of fishing, the most serious forms of fishing by sportsmen, and also the “expense fishing” of those who fish for pleasure but sell their catch to cover some costs.

Recreational fishing takes place in a variety of settings. Variants on the recreational fishing theme include: 1) anglers fishing from their own boats, 2) anglers fishing from shore (e.g. on piers,

beaches, riverbanks), 3) anglers who rent boats that they operate, 4) anglers who fish on charter boats (see glossary) with captains and crew, 5) anglers who fish on party boats (see glossary) with captains and crew, and 6) anglers who fish in tournaments and derbies.

As pointed out earlier, commercial and subsistence fishermen often congregate and reside in villages, communities, small towns, and neighborhoods. Although recreational fishermen do, at times, dwell in a particular geographic region, they are also very likely to be widely distributed. In many instances of fishery management, recreational fishermen are better regarded analytically as a community of interest than as a place-based community.

Recreational fishing has enormous value to participants and those who provide direct services and equipment, as well as local communities. While recreational fishing is frequently discussed in terms of its economic value, it also has important social and cultural values (Smith, 1980).<sup>20</sup> The sociocultural value of recreational fishing can be measured on multiple levels including relationships associated with the fishing trip itself and with the experience of fishing (e.g. with family or friends), with distribution of the catch, and with talking about fishing, i.e. “fish talk.” There are also benefits to the individual such as fulfilling psychological needs like independence, risk taking, relaxation, and identity affirmation (Smith, 1980; Ditton et al., 1992; Fedler and Ditton, 1994; Ditton, 1996; Fedler, 2000; Ditton and Sutton, 2004).

To illustrate the kinds of analytical questions an SIA might address in the context of a recreational fishery, we draw upon events in southern California between 1998 and 2003 that resulted in the designation of a network of marine protected areas (MPA’s) in the Channel Islands area. The simplified fishery SIA model (Fig. 2) is again our starting point, and the specific variables in the following example are illustrated in Figure 6. The Channel Islands of interest—which

include the islands of San Miguel, Santa Rosa, Santa Cruz, Anacapa, and Santa Barbara—lie off the California cities of Santa Barbara and Los Angeles.

The islands and the adjacent marine environment have long been valued for their considerable fishing resources and wildlife amenities. In 1980, Federal actions created the Channel Islands National Park and also the Channel Islands National Marine Sanctuary (CINMS).<sup>21</sup> The park boundary extends to 1 n.mi. off the islands; the sanctuary boundary extends to 6 n.mi. offshore (management).

Beginning in the late 1990’s, a combination of special-interest-group initiatives (external forces), innovative state legislation, and natural resource management actions culminated in the creation of a network of MPA’s (management) in California waters (NMPAC, 2003; Bernstein et al., 2004). In 1998, the California Fish and Game Commission (CFGF), which sets fishery policy for California state waters, received a recommendation from a group of citizens (including a very prominent recreational fisherman) who had formed the Channel Islands Marine Resources Restoration Committee to set aside 20% of a 1 n.mi. zone around the northern Channel Islands for no-take marine reserves (external forces).

In response to this request and in recognition of the need for a community process, CINMS and the California Department of Fish and Game (CDFG), which implements CFGF policies, developed a joint Federal/state partnership to examine MPA issues in the sanctuary.<sup>22</sup> In 1999, California enacted the Marine Life Protection Act (MLPA). This landmark legislation established a legal mandate for the creation of a system of MPA’s (management).

<sup>21</sup>Public Law 96-199 created the Channel Islands National Park. The Channel Islands National Marine Sanctuary was designated under the authority of the Marine Protection, Research and Sanctuaries Act of 1972. Pub.L. 92-532. See Fed. Regis., 45(193): 1980, Rules and Regulations, p. 65200.

<sup>22</sup>Discussion here is limited to Phase I (1999–2003) which concerned Channel Island National Marine Sanctuary waters under state jurisdiction. Phase II which concerns CINMS waters under Federal jurisdiction still continues.

<sup>20</sup>Driver (1983) provides a valuable master list of items and domains of experience for exploring recreation fishermen’s preferences.



In 1999, the Sanctuary Advisory Council (SAC), an advisory group to the sanctuary manager, created a stakeholder-based community group called the Marine Reserves Working Group (MRWG). This group in turn created a Science Advisory Panel and a Socioeconomic Advisory Panel (management). In 2000, both panels recommended the creation of at least one reserve (but not more than four) comprising between 30 and 50% of the representative habitat in each area.

In reference to this recommendation, the socioeconomic panel (Davis, 2001, cited in NMPAC, 2003:31), estimated that a closure of 50% of the sanctuary would result in a maximum potential loss of about 50% in fishing industry revenue for both the commercial and recreational sectors (management). In 2001, MRWG reported to SAC that while members agreed on MPA goals, objectives, and issues (i.e. ecosystem biodiversity, socioeconomic issues, sustainable fisheries, natural and cultural heritage, and education) the group could not agree on one unified spatial recommendation. Importantly, two MRWG members representing recreational fishing constituencies sharply disagreed with recommendations from the Science Advisory Panel. In response, SAC forwarded all materials developed by MRWG and its two panels to the CINMS manager (management).

In 2001 CINMS and CDFG developed a preferred alternative based on the work of the MRWG and advisory panels and presented this to the CFGC (California Department of Fish and Game, 2006:64). In October 2002—and after extensive public review and discussion—the Commission approved the preferred alternative. This established a MPA network consisting of 1) ten (no-take) state marine reserves, 2) a state marine conservation area permitting limited recreational fishing off of Santa Cruz Island, and 3) another state marine conservation area permitting limited recreational and commercial fishing off of Anacapa Island. The total area protected with the system equaled 19% of the state waters within the sanctuary (Ugoretz, 2002:E-2; see also National Marine

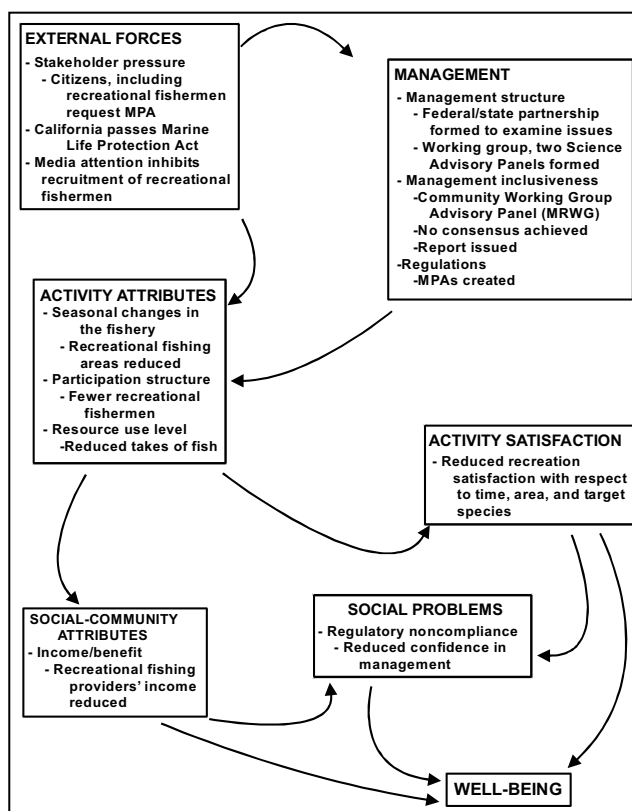


Figure 6.—Model of selected variables affecting the recreational fishery in the Channel Islands, Calif.

Protected Areas Center and NOAA Coastal Services Center, 2003:25–50). The state's MPA network went into effect 9 April 2003 (NOS, 2003:27990) (management).

The combined external forces and management actions discussed above have led to changes in areas where recreational fishermen may fish (activity attributes). One observer has argued that the substantial and prolonged media attention (external forces) to the creation of no-take reserves has inhibited the recruitment of recreational fishermen (Osborn, 2005:12) and also changed demand for recreational fishing providers (social-community attributes, activity attributes).

The potential loss of confidence in the fishery management regime among some recreational fishermen may precipitate social problems such as noncompliance. When all of the interactions of forces discussed above

are taken into account, we believe that it is probable that the marine reserve process has negatively affected the activity satisfaction and well-being of some recreational fishermen, although this has not been directly assessed. At least on the perceptual level, some recreational fishermen may see the potential for their well-being to be reduced. Subsequent research can try to determine whether these perceptions are real. Relationships between all these variables are depicted in Figure 6.

## Discussion

In this paper, we have introduced a general model for social impact assessment in the context of fishery management, especially as conducted by Federal and state executive agencies in the United States. Our model creates opportunities for social research tailored to examine (e.g. by correlation, by causality, via prediction and simulation) the

interplay of an array of social variables (e.g. individual and community attributes, social problems, job and other satisfactions, policy decisions), and their effect on community and individual well-being.

Although the model allows the analyst to study how these variables are related to one another, the most obvious overarching use of the model calls for the treatment of these social factors as independent variables that collectively influence the key dependent variable well-being. In elaborating on our model, we demonstrated that social impact assessment takes one of three analytical forms depending on whether the fishery in question is commercial, subsistence, or recreational.

This SIA model is heuristic and can be used to develop a truly quantitative model. Other researchers, in other contexts, have used all of the variables included in the model, and methods have been developed to quantitatively evaluate them at some level of measurement (nominal, ordinal, and interval). However, the variables have not been assessed together in terms of the model presented here. Ideally, some form of causal modeling should be used to test the heuristic model. Such a test would require obtaining data on included variables and testing the model using accepted methods (Blalock, 1964; Asher, 1983; Lieberman, 1985).

This could result in a predictive model that would allow one to change parameters in one part of the model and determine effects in the variable of interest (i.e. well-being). This process would also result in quantitative assessment of the relative importance of variables proposed for the model, perhaps resulting in some reduction in data needs. It is important to base assessments of the relative importance of different variables on quantitative evidence rather than unsubstantiated predictions.

We offer several recommendations regarding fishery applications of SIA. First, we believe this SIA model is useful as a foundation. Nonetheless, we stress that fishery SIA should not depend on any rigid obedience to one model, but it must continue to evolve methodologi-

cally in response to changing fishery realities.

Second, we must remember that fishery SIA is a requirement of Federal and other law to ensure that the best available science is provided to policy-makers.<sup>23</sup> It is important to understand that SIA is a procedure to describe and predict the sociocultural impacts on selected human populations. It should not be used as a weapon to strategically manufacture “winners” in the policy arena. SIA conclusions are a specification of impacts and may be either negative or positive or both, and may be of major or minor significance. In the final analysis, SIA results are simply factors among others related to economic, biological, and habitat conditions to be considered by fishery managers in determinations of fishery management alternatives.

Third, we need to point out that the kind of SIA analysis outlined here requires data be compiled on many variables for which data are not now available (see appendix) at either the community, or, where appropriate, the individual level. Collection of these data requires NMFS to invest substantially in data collection and compilation and in new research. The recent expansion of the sociocultural analysis program began less than 5 years ago, and while its current funds have allowed it to begin compiling baseline information in each NMFS region<sup>24</sup>, it will need

substantially more funding and staff to collect the wider array of data required by this model. Good quality sociocultural analysis is no less expensive than good quality economic analysis or fish stock assessment.<sup>25</sup>

In conclusion, we note that SIA is a method that needs to grow in rigor and in its ability to evaluate relationships between variables. It is our expectation that with advances in social science theory and quantitative methodology, SIA will evolve in a manner that supports sound fisheries policy making and management. While commercial and recreational fishing will remain central foci of fisheries management, we envision a broader set of problems to which SIA in marine resource management and conservation is valuable. For example, increasing attention is being given to marine protected areas, open ocean aquaculture, ocean-based energy resources, and marine resource dependent tourism, such as whale watching. In the future, we foresee expanded application of SIA to these and other emergent marine resource management issues. The model presented here provides advice and recommendations that can also be applied to these issues.

### Glossary

**Activity satisfaction:** The degree to which one's needs or wants are fulfilled in the conduct of a specific activity.

**Charter boat:** Any vessel-for-hire engaged in recreational fishing and hired for a charter fee by an individual or group of individuals (for the exclusive use of that individual or group of individuals), which results in that vessel being unavailable for hire to any other individual or group of individuals during the period of the charter (Blackhart et al., 2005).

**Job satisfaction:** See activity satisfaction—carrying out a job is a type of activity.

<sup>23</sup>In a recent article, Vanclay (2006) compares the principles of U.S. and international approaches to SIA, and concludes that the U.S. approach as described in ICPGSA (2003), is “positivist/technocratic” in contrast to the “democratic, participatory, and constructivist” approach of the international SIA community (Vanclay, 2003). While the approach adopted by some in the international community has its attractions, social impact assessment work conducted for management actions by U.S. Federal agencies including fisheries must continue to use the best available science until such time as the relevant laws are changed to require something else.

<sup>24</sup>For examples, see the new Alaskan community profiles at <http://www.afsc.noaa.gov/Quarterly/amj2004/amj04feat.pdf>, accessed 11 July 2006, and the Gulf of Mexico Community profiles at <http://sero.nmfs.noaa.gov/economics/economics.htm>, accessed 11 July 2006. Similar profiles are nearing completions for other NMFS regions. Colburn et al. (2006) provides a more complete description of the developing program.

<sup>25</sup>Currently, U.S. Fishery Management Council administrative processes often include last minute changes in proposed regulations, thus restricting the ability of analysts to carry out ideal SIA's such as those implied by this conceptual model. Without changes to the regulatory process itself, it will remain difficult to meet the ideal.

Party boat (also called a head boat): Any vessel-for-hire engaged in recreational fishing and hired (or leased, in whole or part) for a per-capita fee on a first-come, first-served basis (Blackhart et al., 2005).

Perceived control: The degree that one feels that they have influence over events impacting some area of concern.

Resilience: The ability of a system to absorb perturbations by adapting to environmental changes (Berkes and Folke, 1998). With regard to humans, it can be defined as the degree to which an individual, family, or community can cope with change without becoming dysfunctional.

Self-esteem: The degree to which one has pride in or respect for oneself.

Social support system: The method by which a social institution such as the family, community, or some larger social group, provides assistance or encouragement to an individual or other social institution.

Well-being: The degree to which an individual, family, or larger social grouping (e.g. community) can be characterized as being healthy (sound and functional), happy, and prosperous.

## Acknowledgments

The SIA Modeling Workshop was held at Belmont Conference Center, Elkridge, Md, 11–12 March 2004. Participants, in alphabetical order, included Susan Abbott-Jamieson (convener), James M. Acheson, Shankar Aswani, Patricia M. Clay, E. Paul Durrenberger, Peter Fricke, Henry P. Huntington, Jeffrey C. Johnson, Kathi Kitner, Marc L. Miller, Bryan Oles, Michael K. Orbach, Richard B. Pollnac, and Courtland L. Smith. The authors wish to thank Linda Putz for providing workshop facilitation and Rosemary Kosaka for providing workshop support.

## Literature Cited

Acheson, J. M., R. B. Pollnac, J. J. Poggie, and J. A. Wilson. 1980. Study of social and cultural aspects of fisheries management in New England under extended jurisdiction (3 vol., 271, 111, 389 p.). Natl. Sci. Found. and Univ. Maine, NSF grant AER77-06018, Wash., D.C., and Orono, Maine.

- Anderson, L. G. 1980. Necessary components of economic surplus in fisheries economics. *Can. J. Fish. Aquat. Sci.* 37(5):858–870.
- Apostle, R. L., L. Kasdan, and A. Hanson. 1985. Work satisfaction and community attachment among fishermen in southwest Nova Scotia. *Can. J. Fish. Aquat. Sci.* 42(2):256–267.
- Asher, H. B. 1983. Causal modeling. 2nd edit. Sage Publ., Beverly Hills, Calif., 97 p.
- Baker, C. 2004. Behavioral genetics. *Am. Assoc. Adv. Sci., Wash., D.C.*, 131 p.
- Barrow, C. J. 1997. Environmental and social impact assessment: an introduction. Edward Arnold, Lond., 310 p.
- Becker, H. 1997. Social impact assessment: method and experience in Europe, North America and the developing world. *Social Res. Today*, vol. 10. UCL Press, Lond., 260 p.
- Berkes, F., and C. Folke, 1998. Linking social and ecological systems for resilience and sustainability. *In* F. Berkes, C. Folke, and J. Colding (Editors), *Linking social and ecological systems: management practices and social mechanisms for building resilience*, p. 1–25. Cambridge Univ. Press, Cambridge, U.K.
- \_\_\_\_\_, R. Mahon, P. McConney, R. B. Pollnac, and R. Pomeroy. 2001. Managing small-scale fisheries: alternative directions and methods. *Int. Develop. Res. Centre*, Ottawa, Can., 309 p.
- Bernstein, B., S. Iudicello, and C. Stringer. 2004. Lessons learned from recent marine protected area designations in the United States. Rep. to Natl. Mar. Protect. Areas Cent., NOAA, Natl. Fish. Conserv. Cent., Ojai, Calif.
- Binkley, M. 1995. Risks, dangers and rewards in the Nova Scotia offshore fishery. McGill-Queen's Univ. Press, Montreal, 192 p.
- Blackhart, K., D. G. Stanton, and A. M. Shimada. 2005. NOAA fisheries glossary. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/SPO-69, 61 p.
- Blalock, H. M., Jr. 1964. Causal inferences in nonexperimental research. Univ. N.C. Press, Chapel Hill, 200 p.
- Bryan, H. 1984. A guide to social analysis—U.S. Forest Service Training Manual. Mimeo. USDA For. Serv., Off. Environ. Coord., Wash., D.C., 206 p.
- Bunce, L., P. Townsley, R. Pomeroy, and R. Pollnac. 2000. Socioeconomic manual for coral reef management. Australian Inst. Mar. Sci., Townsville, Queensland (for GCRMN, IUCN, NOAA, UNEP, and Environ. Agency Jpn.), 251 p.
- Burch, W. R., and D. R. DeLuca. 1984. Measuring the social impact of natural resource policies. Univ. New Mex. Press, Albuquerque, 216 p.
- Burdge, R. J. (Editor). 1994. A conceptual approach to social impact assessment. *Social Ecology Press*, Middleton, Wisc., 256 p.
- \_\_\_\_\_. 2004. A community guide to social impact assessment. third ed. *Social Ecology Press*, Middleton, Wisc., 192 p.
- California Department of Fish and Game (CDFG). 2006. California Marine Life Protection Act: Appendices to the Master Plan (revised draft 21 July 2006) (Including Appendix H. Summary of Recent and Ongoing Processes Related to the Marine Life Protection Initiative, p. 60–68 [revised November 2004], 190 p. Online at [http://www.dfg.ca.gov/mrd/mlpa/pdfs/APP\\_entire\\_MLPA.MP.pdf](http://www.dfg.ca.gov/mrd/mlpa/pdfs/APP_entire_MLPA.MP.pdf) (accessed 1 May 2007). For separate chapters, appendices, and updates, see <http://www.dfg.ca.gov/mrd/mlpa/masterplan2006.html> (accessed 1 May 2007).
- Cantril, H. 1963. A study of aspirations. *Sci. Am.* 208(2):41–45.
- Childers, H. 2007 The 3 keys to IFQs: allocation, allocation, allocation. *Natl. Fisher.* 87(12):21.
- Colburn, L., S. Abbott-Jamieson, and P. M. Clay. 2006. Anthropological applications in the management of federally managed fisheries: context, institutional history, and prospectus. *Hum. Organ.* 65(3):231–239.
- Colfer, C. J. P., and Y. Byron (Editors). 2001. *People managing forests. Resour. Future Press*, Wash., D.C., 352 p.
- Davis, J. 2001. Science as a central tool in planning marine reserves: case study of the Channel Islands. *MPA News* 2:10(May). Online at <http://depts.washington.edu/mpanews/MPA19.htm#Channel> (accessed 28 July 2006).
- Ditton, R. B. 1996. Understanding the diversity among largemouth bass anglers. *Am. Fish. Soc. Symp.* 16:135–144.
- \_\_\_\_\_, and S. G. Sutton. 2004. Substitutability in recreational fishing. *Human Dimensions Wildl.* 9(2):87–102.
- \_\_\_\_\_, D. K. Loomis, and S. Choi. 1992. Recreation specialization: reconceptualization from a social worlds perspective. *J. Leisure Stud.* 24(1):35–51.
- Driver, B. L. 1983. Master list of items for recreation experience preference scales and domains. USDA For. Serv. Rocky Mountain Forest and Range Experiment Station, Ft. Collins, Colo. Unpubl. doc., 10 p. Online at <http://wilderness.com/html/DriverREPScales.doc>, accessed 1 May 2007.
- Eckersley, R., J. Dixon, and B. Douglas. 2001. The social origins of health and well-being. *Camb. Univ. Press, Camb., U.K.*, 368 p.
- Faragher, E. B., M. Cass, and C. L. Cooper. 2005. The relationship between job satisfaction and health: a meta-analysis. *Occup. Environ. Med.* 62(2):105–112.
- Fedler, A. J. 2000. Participation in boating and fishing: a literature review. Rep. prep. for Recreational Boating Fish. Found., Alexandria, Virg., Sept. 2000, 63 p.
- \_\_\_\_\_, and R. B. Ditton. 1994. Understanding angler motivations in fisheries management. *Fisheries* 19(4):6–13.
- Finsterbusch, K., and W. R. Freudenburg. 2002. Social impact assessment and technology assessment. *In* R. E. Dunlap and W. E. Michelson (Editors), *Handbook of environmental sociology*, p. 407–447. Greenwood Press, Westport, Conn.
- \_\_\_\_\_, L. G. Llewellyn, and C. P. Wolf (Editors). 1983. *Social assessment methods*. Sage Publ., Beverly Hills, Calif., 318 p.
- \_\_\_\_\_, and C. P. Wolf (Editors). 1977. *Methodology of social impact assessment*. Dowden, Hutchinson and Ross, Stroudsburg, Pa., 387 p.
- Freeman, M. M. R. 2005. Just one more time before I die: securing the relationship between Inuit and whales in the arctic regions. *In* N. Kishigami and J. M. Savelle (Editors), *Indigenous use and management of marine resources*, p. 59–76. *Senri Ethnol. Stud.* 67, Natl. Mus. Ethnol., Osaka, Jpn.
- Freudenburg, W. R. 1986. Social impact assessment. *Annual Rev. Sociol.* 12:451–478.
- Gatewood, J. B., and B. J. McCay. 1990. Comparison of job satisfaction in six New Jersey fisheries. *Hum. Organ.* 49(1):14–25.
- Georgette, S., D. Caylor, and E. Trigg. 2004. Subsistence salmon harvest summary north-

- west Alaska 2003: Norton Sound District, Port Clarence District, Kotzebue District. Alaska Dep. Fish Game, Div. Subsistence, Juneau & Kawerak, Inc., Nome, 46 p.
- Gilden, J. (Editor). 1999. With F. D. L. Conway, S. Cordary, L. Cramer, C. Kinley, G. Goblish, and C. Smith. 1999. Oregon's changing coastal fishing communities, *Oreg. State Univ. Sea Grant Rep. ORESU-O-99-001*, 82 p.
- Gullone, E., and R. A. Cummins (Editors). 2002. The universality of subjective well-being indicators: a multidisciplinary multinational perspective. Kluwer Acad. Publ., Dordrecht, Netherl., 196 p.
- Heslop, P., G. D. Smith, C. Metcalfe, J. Macleod, and C. Hart. 2002. Change in job satisfaction, and its association with self-reported stress, cardiovascular risk factors and mortality. *Social Sci. and Medicine* 54(10):1589–1599.
- Hobart, W. L. (Editor). 1995. Baird's legacy: the history and accomplishments of NOAA's national marine fisheries service, 1871–1996. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/SPO-18, 47 p.
- ICGPSIA. 1994. Guidelines and principles for social impact assessment. Interorganizational Committee on Guidelines and Principles for Social Impact Assessment. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-F/SPO-16, 26 p.
- \_\_\_\_\_. 2003. Principles and guidelines for SIA in the USA. *Impact Assess. Proj. Appraisal* 21(3):231–250.
- Kishigami, N. 2005. Co-management of beluga whales in Nunivak (Arctic Quebec), Canada. *In* N. Kishigami and J. M. Savelle (Editors), *Indigenous use and management of marine resources*. *Senri Ethnol. Stud.* 67:121–144. *Natl. Mus. Ethnol.*, Osaka, Jpn.
- Kogut, M. A. 1976. Social impact assessment: an annotated bibliography. *Dep. Ecol.*, Olympia, Wash., 30 p.
- Krebs, C. J. 1989. *Ecological methodology*. Harper & Row, N.Y., 654 p.
- Liebertson, S. 1985. Making it count: the improvement of social research and theory. *Univ. Calif. Press*, Berkeley, 257 p.
- Loy, W. 2006. Crab in question: crew members and others in new quota fishery want to know: what's rational about this? *Natl. Fisherman* 86 (12):34–37.
- Magdanz, J. S., C. J. Utermohle, and R. J. Wolfe. 2002. The production and distribution of wild food in Wales and Deering, Alaska. *Div. Subsistence, Alaska Dep. Fish Game, Juneau, Tech. Pap.* 259, 179 p.
- McCay, B., J. B. Blinkoff, R. Blinkoff, and D. Bart. 1993. Fishery impact management project: rep., pt. 2, phase 1, to the Mid-Atlantic Fishery Management Council. *Mid-Atl. Fish. Manage. Council*, Dover, Del., 179 p.
- Mederer, H. 1999. Surviving the demise of a way of life: stress and resilience in northeastern fishing families. *In* H. I. McCubbin, E. Thompson, A. I. Thompson, and J. A. Futrell (Editors), *The dynamics of resilient families: resiliency in families*, vol. 4, p. 203–235, Sage Publ., Thousand Oaks, Calif.
- NOAA, National Marine Protected Areas Center (NMPAC), and NOAA Coastal Services Center (NCSC). 2003. Marine Protected Area (MPA) process review: Case studies of five MPA establishment processes. NOAA /NOS Train. Tech. Assist. Inst., Charleston, S.C., 125 p. (Online at <http://mpa.gov/pdf/helpful-resources/mpalessons-learned.pdf>, accessed 1 May 2007.)
- NMFS. 1998. Magnuson-Stevens Act provisions; National Standard Guidelines. *Fed. Regist.* 63(84):24211–24237. Online at <http://www.st.nmfs.gov/st1/econ/cia/natstand-final.pdf>, accessed 22 August 2005.
- \_\_\_\_\_. 1999. Ecosystem-based fishery management. A report to Congress by the ecosystems principles advisory panel, David Fluharty, chair. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Silver Spring, Md. Online at <http://www.nmfs.noaa.gov/sfa/EPAPrpt.pdf>, accessed 2 May 2007.
- \_\_\_\_\_. 2001. NMFS Operational Guidelines—Fishery Management Process Appendix 2(g), Guidelines for Assessment of the Social Impact of Fishery Management Actions. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv., Silver Spring, Md. Online at [http://www.nmfs.noaa.gov/sfa/reg\\_svcs/social\\_impact\\_assess.htm](http://www.nmfs.noaa.gov/sfa/reg_svcs/social_impact_assess.htm), accessed 23 July 2006.
- NOS. 2003. Announcement of intent to initiate the process to consider marine reserves in the Channel Islands National Marine Sanctuary; Intent to prepare a draft environmental impact statement. *Fed. Regist.* 68(99): 27989–27990. Online at [http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=2003\\_register&docid=fr22my03-60.pdf](http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=2003_register&docid=fr22my03-60.pdf), accessed 4 May 2007.
- Norris, F. 2002. Alaska subsistence: a National Park Service management history. *Dep. Inter., Natl. Park Serv., Alaska Support Office, Anchorage*, 306 p.
- Osborn, B. 2005. Ocean parks: part II. *United Anglers of Southern California Fall Newsl.* Online at <http://www.unitedanglers.com>, accessed 13 July 2006.
- Osgood, C. E., G. J. Suci, and P. H. Tannenbaum. 1957. The measurement of meaning. *Univ. Ill. Press*, Urbana, 342 p.
- OSU. 1978. Socio-economics of the Idaho, Washington, Oregon and California coho and chinook salmon industry. *Oreg. State Univ., Dep. Agric. Resour. Econ., Oreg. Sea Grant, Corvallis*, 390 p.
- Poggie, J. J., and C. Gersuny. 1974. Fishermen of Galilee. *Mar. Bull.* 17, *Univ. Rh. I., Kingston RI*, 116 p.
- Pollnac, R. B. 1988. Social and cultural characteristics of fishing peoples. *Mar. Behavior Physiol.* 14(1):23–39.
- \_\_\_\_\_. 1998. Rapid assessment of management parameters for coral reefs. *Coast. Resour. Cent., Univ. R.I., Narragansett*, 199 p. Online at <http://www.crc.uri.edu>, accessed 2 May 2007.
- \_\_\_\_\_, and B. R. Crawford. 2000. Assessing behavioral aspects of coastal resource use. *Coast. Resour. Cent., Univ. R.I., Narragansett*, 139 p. Online at <http://www.crc.uri.edu>, accessed 13 July 2006.
- \_\_\_\_\_, and J. J. Poggie. 1980. Perceptions of the occupation of small-scale fishermen. *In* J. G. Sutinen and R. B. Pollnac (Editor), *Small scale fisheries in Central America: acquiring information for decision making*, p. 243–265. *Int. Cent. Mar. Resour. Manage., Univ. of R.I., Kingston*.
- \_\_\_\_\_, and \_\_\_\_\_. 1988. The structure of job satisfaction among New England fishermen and its application to fisheries management policy. *Am. Anthropol.* 90(4):888–901.
- \_\_\_\_\_, and \_\_\_\_\_. 2006. Job satisfaction in the fishery in two southeast Alaskan towns. *Hum. Organ.* 65(3):329–339.
- \_\_\_\_\_, \_\_\_\_\_, and S. L. Cabral. 1998. Thresholds of danger: perceived risk in a New England fishery. *Hum. Organ.* 57(1):53–59.
- \_\_\_\_\_, R. S. Pomeroy, and I. H. T. Harkes. 2001. Fishery policy and job satisfaction in three southeast Asian fisheries. *Ocean Coast. Manage.* 44(7–8):531–544.
- \_\_\_\_\_, and R. Ruiz-Stout. 1977. Artisanal fishermen's attitudes toward the occupation of fishing in the Republic of Panama. *In* R. B. Pollnac (Editor), *Panamanian small scale fishermen*, 88 p. *Univ. R.I. Mar. Tech. Rep.* 44. *Univ. R.I., Kingston*, 88 p.
- Pomeroy, R. S., R. B. Pollnac, B. M. Katon, and C. D. Predo. 1997. Evaluating factors contributing to the success of community-based coastal resource management: the central Visayas regional project-1, Philippines. *Ocean Coast. Manage.* 36(1–3):97–120.
- Ryan, R. M., and E. I. Deci. 2001. On happiness and human potentials: a review of research on hedonic and eudaimonic well-being. *Annu. Rev. Psychol.* 52:141–166.
- Sepez, J. 2001. Political and social ecology of contemporary Makah subsistence hunting, fishing and shellfish collecting practices. *Ph.D. Dissert. Univ. Wash., Seattle*, 249 p.
- Shannon, C. E., and W. Weaver 1949. The mathematical theory of communication. *Univ. Ill. Press, Urbana*, 125 p.
- Sharp, S., and D. Lach. 2003. Integrating social values into fisheries management: a Pacific Northwest study. *Fisheries* 28(4):10–15.
- Sharpe, A. 1999. A survey of indicators of economic and social well-being. Background paper prepared for Canadian Policy Research Networks, Ottawa, 73 p. Online at [http://epe.lac-bac.gc.ca/100/200/300/cprn/english/sie\\_e.pdf](http://epe.lac-bac.gc.ca/100/200/300/cprn/english/sie_e.pdf), accessed 12 July 2006.
- Shields, M. A. 1974. Social impact assessment: an analytic bibliography. Report to the U.S. Army Engineer. U.S. Army Engineer Institute for Water Resources, Fort Belvoir, Virginia, Paper 74-P6, 129 pages. Online at <http://stinet.dtic.mil/oai/?&verb=getRecord&metadataPrefix=html&identifier=ADA003245>, accessed 30 April 2007.
- Sievanen, L., B. Crawford, R. B. Pollnac, and C. Lowe. 2005. Weeding through assumptions of livelihood approaches in ICM: seaweed farming in the Philippines and Indonesia. *Ocean Coast. Manage.* 48(3–6):297–313.
- Sirgy, M. J. 2002. The psychology of quality of life. *Kluwer Acad. Publ., Dordrecht, Netherl.*, 296 p.
- Smith, C. L. 1980. Attitudes about the value of steelhead and salmon angling. *Trans. Am. Fish. Soc.* 109(3):272–281.
- \_\_\_\_\_. 1981. Satisfaction bonus from salmon fishing: implications for economic evaluation. *Land Econ.* 57(2):181–194.
- Smith, S., S. Jacob, M. Jepson, and G. Israel. 2003. After the Florida net ban: the impacts on commercial fishing families. *Soc. Nat. Resour.* 16(1):39–59.
- Stewart, H. 2005. The fish tale that is never told: a reconsideration of the importance of fishing in Inuit societies. *In* N. Kishigami and J. M. Savelle (Editors), *Indigenous use and management of marine resources*, p. 345–361. *Senri Ethnol. Stud.* 67, *Natl. Mus. Ethnol.*, Osaka, Jpn.
- Suh, E. M., and E. Deiner. 2003. Culture and subjective well-being. *MIT Press, Camb., Mass.*, 365 p.
- Taylor, C. N., C. H. Bryan, and C. G. Goodrich. 2004. Social assessment: theory, process and techniques. *Taylor Baines and Assoc., Christchurch, New Zealand*, 194 p.

- Ugoretz, J. 2002. Marine protected areas in the National Oceanic and Atmospheric Administration's Channel Islands National Marine Sanctuary. Final 2002 environmental document, Vol. 1, California Department of Fish and Game [http://www.dfg.ca.gov/mrd/ci\\_ceqa/pdfs/summary.pdf](http://www.dfg.ca.gov/mrd/ci_ceqa/pdfs/summary.pdf), 5 p. and [http://www.dfg.ca.gov/mrd/ci\\_ceqa/pdfs/chapter2.pdf](http://www.dfg.ca.gov/mrd/ci_ceqa/pdfs/chapter2.pdf), 18 p. For all chapters, appendices, and updates, see, <http://www.dfg.ca.gov/mrd/ci%5Fceqa/#vol1> (accessed 1 May 2007).
- USHEW. 1973. Work in America: report of a special task force to the Secretary of Health, Education, and Welfare. MIT Press, Camb., Mass., 262 p.
- USDOT. 1982. Social impact assessment: A sourcebook for highway planners. U.S. Dep. Transportation, Fed. Highway Admin., Off. Res. Develop., Environ. Div., Wash., D.C., 525 p. Natl. Tech. Inform. Serv., Springfield, Virg., PB83209452.
- Vancly, F. 2003. International principles for social impact assessment. *Impact Assess. Proj. Appraisal* 21(1):5–11.
- \_\_\_\_\_. 2006. Principles for social impact assessment: a critical comparison between the international and U.S. documents. *Environ. Impact Assess. Rev.* 26(1):3–14.
- Zumbo, B. D. 2002. Advances in quality of life research 2001. Kluwer Acad. Publ., Dordrecht, Netherl.

## APPENDIX: Evaluation of SIA Variables

For marine resource SIA's, we recommend first constructing a table to facilitate systematic identification of both the units of analysis and the relevant variables for assessing impacts. Typically, units of analysis (e.g. individuals, firms, communities, tribes, regions) are the rows, while SIA variables are the columns.

Appendix Table 1 provides a comprehensive list of variables from which to choose those relevant for a particular SIA. It includes constructs, associated variables, and some measurement options for each. The long-term objective is to work toward agreement among marine social scientists on consistent operational definitions and standard, accepted measures for each. Consistent operationalization of SIA variables is necessary for making comparisons both across marine resource management SIA's and across time within a resource management SIA.

Some of the variables are in fact indices. Establishing defensible indices is difficult, but can be done by building an index based on work already completed. This appendix, the NOAA

(1998, 2001) MSA National Standards and SIA operational guidelines, and historical examples (Pomeroy et al., 1997; Pollnac, 1998; Pollnac and Crawford, 2000; Berkes et al., 2001) all provide a basis for developing useful indices.<sup>26</sup> In all cases, the measures should enable global comparisons. What should be situation specific is the effort to explain the direction and magnitude of change in the index of well-being for particular individuals or groups of individuals at a particular point in time. Explaining why the index has risen or fallen or projecting future trends is the most useful outcome of SIA. The commercial, recreational, and subsistence examples provided in this article illustrate the system's approach and templates as applied to representative marine resource management problems.

## Meta-Methodological Considerations

### Levels of Measurement

Data should be obtained at the most precise level of measurement appropriate to the variable under consideration to facilitate statistical analyses. It is understood, however, that availability of information or funds to gather information may result in varying levels of precision. Hence, a useful database should accommodate different levels of measurement and provide descriptions of the methods used to facilitate appropriate interpretation of the data (Pollnac, 1998).

For example, the relative degree of solidarity in a community could be based on counts of cooperative organizations, churches, social organizations, and their membership. The total number of organizations, or total membership in such organizations, could be analyzed relative to the total population of a com-

munity. This value would be the most precise measure of relative solidarity across communities.

Alternatively, where such statistics are not available, the figure could be based on informant interviews where fishermen and other community members would be asked to list and rank the top five communities in terms of solidarity. Modal ranks for each community could be determined and used as a ranking of relative importance. In this case the level of measurement would be ordinal and not as precise as the previous measure. Nonetheless, it can be used in statistical analysis.

Sometimes information sources will use concepts such as low, medium, high, or some variant of these concepts to indicate a level of importance or use. Despite the fact that these are evaluative concepts, not numbers, they can be converted to numbers signifying an ordinal value. For example, the concepts none, low, medium, and high can be converted to the ordinal values 0, 1, 2, and 3, respectively.

It is extremely important that the direction (in terms of relative amount) of the ordinal values be known. For example, when ranking tasks are performed (e.g. ranking the relative levels of solidarity as in the example above), the top ranked community in terms of solidarity is usually given the rank of "number one" and the least important "number five," or whatever the total number ranked ends up to be. In terms of the direction of these numbers as related to the concept "importance" the numbers are the inverse (in terms of ordinal quantity reflected by 1, 2, 3, etc.) of the actual ordinal quantity.

Correlational analyses using ranks where one is "most important" can be potentially misleading since if this variable is entered into a correlation analysis with another variable where a higher number equals a higher level of the variable, the sign in the result will be negative when the correlation is in fact positive. Hence, in all cases in this database where the ordinal quantity of the concept being measured is higher than another ordinal quantity, the numeric value assigned will be higher.

<sup>26</sup>Other disciplines have constructed indices that are now commonly used. Economists constructed gross domestic product and unemployment as economic health measures. The index of consumer satisfaction is an economic bellwether, based on response to survey questions. Ecologists developed the Shannon-Weaver (1949) index of diversity (Krebs, 1989). Even temperature is a constructed index in which some societies use a Fahrenheit and in others a Celsius scale.

Finally, continuing with the relative solidarity example, in some cases the source of information may only indicate several communities as having a high degree of solidarity with no ranking. Here we have a simple dichotomy where a given community has solidarity or not—a simple yes/no, limited choice. This type of information is better than none at all, and it can also be used in statistical analysis; hence, accommodation will be made for it in the database. Therefore, each indicator, as appropriate, will have fields for different levels of measurement.

### Perceptions

In the description of the variables, remember that there is often more than one measure of a given variable. We often move from actual observation using instruments or our senses, to official records, to triangulated key informant interviews, to individual perceptions. Ideally, the method used to evaluate perceptions of phenomena such as aspects of family and social problems, job satisfaction, level of community conflict, or ability to work together will be able to take advantage of the human ability to make graded ordinal evaluations.

For example, one has the ability to evaluate real world objects in terms of some attribute such as size and not only make the judgment that one is larger than the other, but also that one is a little larger, larger, much larger, or very much larger. Human behavior is based on graded ordinal judgments, not simply a dichotomous judgment of present or absent. For example, a person is more likely to take action if they perceive that an activity will benefit them “greatly” in contrast to “just a little.” This refined level of measurement allows one to make more refined assessments concerning fisheries management impacts, as well as permitting use of more powerful statistical techniques to determine relationships between perceived impacts and potential predictor variables. There are several techniques that can be used to evaluate individual perceptions of the indicators we have identified.

One commonly used procedure for measuring degree of satisfaction or dissatisfaction is a Likert-type scale. In this procedure, the researcher asks the subjects to report how satisfied or dissatisfied they are with certain aspects of their occupation, community, or living conditions. If they respond “satisfied,” they are then asked if they are “very satisfied,” “satisfied,” or “just a little satisfied.” The same procedure is applied to a “dissatisfied” response.

Including the “neither” or neutral response, results in a 7-point scale, with 1 indicating very dissatisfied and 7 very satisfied. This is more an example of a semantic differential (Osgood et al., 1957). Respondents would be requested to make these judgments for two time periods: today and pre-implementation of the fishery management procedure. Clearly, this would be a cumbersome, time-consuming process with more than just a few indicators. Additionally, the technique might prove to be unreliable for uncovering minor changes between time periods due to the size of the categories used.

Another technique is a visual, self-anchoring, ladder-like scale, which allows for finer ordinal judgments, places fewer demands on informant memory, and can be administered more rapidly (Cantril, 1963). The subject is shown a ladder-like diagram with multiple steps, where the first step represents the worst possible situation.

For example, with respect to community harmony, the first step would indicate a community with a great deal of conflict, and where community members are involved in a great deal of verbal conflict over various issues such as school taxes, waterfront planning, immigrant populations, etc. The highest step would be described as a conflict free community in which town meetings are characterized by pleasant interaction, where consensus is easily achieved, no issues exist dividing the population, and peaceful interaction is normal.

In a fisheries application, the subject would then be asked where on a ladder (ruler, scale, whatever is appropriate for

the subjects involved) the local area is today (the self-anchoring aspect of the scale). The subject would then be asked to indicate where it was before implementation of the fishery management procedure or some other earlier period to establish a baseline. The difference between the two time periods is the measure of change.

The two techniques described above do not provide the same information. The information is similar, but subject to slightly different interpretations. For example, a position on the self-anchoring scale does not necessarily indicate satisfaction or dissatisfaction, and we might be in error if we interpret a scale value above the mid-point as indicating individual satisfaction.

Likewise, satisfaction with an attribute (e.g. income) does not tell us where in the perceived range of income the individual places himself/herself. The self-anchoring scale, however, is both easier to administer and more sensitive to the changes we need to evaluate. For some applied examples see Pollnac and Crawford (2000).

While this discussion assumes that a sample of individuals will be interviewed, focus groups and/or scoping meetings are also commonly used. Social psychology researchers have demonstrated, however, that group responses are influenced by the most powerful or persuasive group members, distorting individual attitudes, beliefs, and values. Nevertheless, the same methods can be applied to a group for a consensus response.

It is suggested, however, that if the group is literate, they be given a printed questionnaire. In all cases, the responses will only reflect group or sample membership, which may not be representative of the target population. Local constraints sometimes require the SIA analyst to rely on opportunistic sampling, rather than on stratified random samples. Even in the opportunistic sampling situation, every attempt should be made to include members of all previously identified relevant populations.

**Appendix Table 1.—SIA model variables.**

Construct group	Constructs	Variables <sup>1</sup>	Suggested measurement strategies
External forces	1. Population pressure	Demographic statistics compared over time, population migration patterns	U.S. Census, comparing population figures over time for locations of interest; Federal government reports documenting changes in population patterns; state and local websites for locations of interest
	2. Stakeholder pressure	No. of environmental NGO-generated lawsuits; no. of news media articles discussing related public pressure; no. of related organized meetings, other events; no. business associations expressing interest; treaty rights	Develop an index of pressure from publicly available information including no. of NGO-generated lawsuits, content analysis of relevant NGO websites, content analysis of news media, and other relevant archival resources
	3. Marine resource levels	Fish stock levels; sea mammal population levels; other marine resources	Specific species or species complex; state and/or Federal fish stock assessments for regions of interest; Federal and state sea mammal population estimates; Federal/state estimates other marine resource levels
	4. Marine resource value	Price; non-market value	NMFS Market News; various governmental and non-governmental price and market surveys; sample survey; archival resources
Management	5. Management structure	Complexity of management	1) Sample survey of perceptions of complexity of the management structure; 2) index including, for example, number of gears managed per year, number of species managed per year, number of management measures introduced per year; number of governance bodies involved; 3) count of jurisdictional entities
	6. Regulations	Fairness, complexity, restrictiveness, and effectiveness of regulations	1) Sample survey of perceptions, 2) archival sources (e.g. news media, lawsuits, NGO, and other scorecards)
	7. Management inclusiveness	Public involvement in management processes	1) Sample survey of perceptions, 2) archives or observations: counts of public comments in documents and number/type of participants at public meetings
	8. Enforcement and compliance	Levels/types of enforcement and noncompliance with activity regulations, whether formal or informal	1) Sample survey/structured interviews/triangulated key informant interviews of individual reports and/or perceptions (including questions about behaviors of others), 2) archival data (e.g. review fisheries law enforcement reports and news media; numbers of citations and infractions, normalized for nonuniform levels of enforcement coverage; creel survey reports)
Activity attributes	9. Annual rounds	Structure of annual round	Sample survey/key informant interviews regarding activity types (marine and non-marine) by month and location. Locations of activities should be mapped, using place names and results of mapping exercises—translated to GIS
	10. Fishing units/gear types	Vessel/gear type combinations	Sample survey; open-ended/structured interviews/pile sorting/consensus analysis; observation-based empirical methods; agency effort and permit data; official license/port/harbor data, if available; observation to ground truth other methods. If conflicting data from various sources, a census may be necessary. Fishing gear taxonomies have been developed by states, interstate commissions, and Federal fisheries managers and vary by region and source.
	11. Fishing method/mode	Method/mode combinations of fishing: 1) shore-based, including man-made and natural structures (e.g. beach, pier, jetty, bridge); 2) party/charter boat; 3) private/rental boat; 4) commercial vessel	Sample survey; open-ended/structured interviews/pile sorting/consensus analysis; observation-based empirical methods; MRFSS; official permit/license/port/harbor data, if available; observation to ground truth other methods. If conflicting data from various sources, a census may be necessary
	12. Resource use level	Harvest level or activity intensity (including avidity), perceptions of abundance. Where feasible identify by mode (i.e. commercial, recreational, or subsistence)	1) Sample survey, open-ended and structured interviews, 2) NMFS landings data, state landings data, subsistence databases, MRFSS, counts of infrastructure, DAS, CPUE, vessel counts, license and permit data, other relevant databases
	13. Resource use patterns	Distribution, processing, and consumption patterns; social networks (including references to reciprocity and other commercial and noncommercial forms of exchange); marketing chains (including references to vertical and horizontal integration)	1) Sample surveys; network analysis; in-depth interviews; triangulated key informant interviews, 2) archival, public information on marketing chains
	14. Cost of entry	For each vessel/gear type combination obtain costs of new and used vessels/gear, license and other fees (e.g. dock fees), and cost of property/access rights; trip expenses (e.g. cost breakdown of transportation, bait, gear, ice, lodging, food, fees); training time expenses; insurance, financing	1) Triangulated key informant interviews (fishermen, vessel/gear salespersons), surveys, in-depth interviews, 2) archives or observations: classified advertisements, party/charter fees, marina slip expense, rental boat fees, launch/ramp fees, license fees, pier fees, lodging costs, etc. Some elements of cost of entry captured in agency economic data collections

*continued*

**Appendix Table 1.—(continued) SIA model variables.**

Construct group	Constructs	Variables <sup>1</sup>	Suggested measurement strategies
	15. Ownership patterns	Individual owner demographic profiles, including age, sex, residency, income, education, total years participating in activity; corporate owned vessels, include years in business, number of vessels owned, a rating or ranking measure of size of business using gross income or proxy measure as possible, location of incorporation of business and principal place of business, number of employees	1) Sample survey/triangulated key informant interviews; 2) public statistics; 3) Coast Guard vessel registry data; 4) state vessel registry data; 5) Federal and state permits databases; 6) Dunn & Bradstreet business registry; state business registries
	16. Participation structure	For each activity type obtain information about participants, including number; positions/roles (e.g. owner captain, captain, engineer, cook, deckhand, shell shucking, ritual specialist) as appropriate; participant hierarchy; general participant selection criteria (e.g. kinsmen if available, friends, levels of skill); and participant demographic information (including residence)	1) Sample survey/triangulated key informant interviews including SSN (can't require it) or crew ID number (only Alaska has crew licenses), vessel ID currently employed, location of owned vessel/plant currently employed in (and plant ID no.), individual or corporate ownership, current ports of landing, 2) licenses and other databases
	17. Safety	Level of safety of the activity	1) Sample survey/individual reports on perceived safety/likelihood of risk-taking behavior, 2) Coast Guard records (CASMAL files), state records, harbor master records normalized for level of enforcement coverage
	18. Physical resources/ infrastructure	Condition and adequacy of activity-related physical resources/infrastructure	1) Sample survey of perceptions; triangulated key informant interviews (including Chamber of Commerce members, fishermen, harbor master, etc.); 2) number of docks, cold stores, distribution and marketing facilities, gear and vessel supply and maintenance facilities, marinas, marine repair, marine supply, party/charter boat operations, boat rentals, bait and tackle shops, marine electronics shops, boatyards, boat lifts, boat storage, boat sales, pay piers, ramps and associated infrastructure, public access sites, fishing clubs and associations, dockside motels/lodging, number of hospitals and other health care facilities, airports, marine ports, factories by industry, major roads, etc.; archival research on comprehensive plans and economic studies of angling in the community
	19. Activity mobility	Mobility within an activity; alternative activities (including jobs, recreation, and subsistence); and substitutability	1) Sample surveys/interviews/triangulated key informant interviews/free listing/pile sorting (including current and former activity participants) on perceived/preferred/potential alternate activities, existing activity structure, activity participants' education and training, social/political capital, physical capital, social stratification, power structure; 2) counts and archival data on available industries/jobs, available formal and informal training and retraining programs and their participation rates, etc.
Activity satisfaction	20. Activity satisfaction	Level of satisfaction derived from or associated with participation in the activity	Sample survey/individual reports including aesthetics, perceived quality/health of the resource, job satisfaction, trip satisfaction, desire to continue participating, desire for children and grandchildren to continue participating, recent vessel and/or equipment purchase
Individual attributes	21. Participant characteristics	Participant demographic profiles, including age, sex, residency, income, education, total years participating in activity	1) Sample survey/triangulated key informant interviews, 2) public statistics, 3) crew licensing data where available
	22. Mental health, individual	Mental health condition of individuals	Sample survey/self report instruments on stress-related disorders and treatment (e.g. depression, stress, drinking, psychosomatic illnesses, anxiety, self-esteem issues, psychiatric care, and counseling)
	23. Physical health, individual	Physical health condition of individuals	Sample survey/individual report instruments of physical health (including heart disease, injuries, diet/nutrition deficiencies/adequacy, especially for subsistence, etc.)
	24. Resilience, individual	Capability of individuals to cope successfully in the face of significant adversity or risk	Sample survey including work history and training, religiosity, self esteem, available support systems, perceived levels of stress, perceived ability to cope, sources of income, level of education, etc.; key informant interviews
	25. Personality traits	Distinctive behavioral regularities across diverse life situations through time	Sample survey using standardized self-report personality trait assessment instruments; relevant questions from Driver <sup>2</sup> , master list of items for recreational experience preference scales and domains; interviews.
Social-community attributes	26. Demographic characteristics	Demographic statistics for place-based and activity-based communities	1) Sample survey of residence patterns, location of activities in relation to residence; 2) U.S. Census, Bureau of Labor Statistics, community strategic plans including total population, sex, age, race, ethnicity, origins and language, housing, owner/renter status, education, employment, housing tenure, housing mortgage status, religious affiliation

*continued*



**Appendix Table 1.—(continued) SIA model variables.**

Construct group	Constructs	Variables <sup>1</sup>	Suggested measurement strategies
			tion; official license/port/harbor data over time, if available; license plate counts from public launches and dock parking lots; licensing databases and other archival data
27. Social stratification	Type and degree of social stratification and differences in place-based and activity communities		1) Sample survey on perceptions/self-reports including income; education; access to social/physical capital and resources; triangulated key informant interviews; 2) construct gini-coefficient (or coefficient of variation, quartile measures) for a) distribution of property values (from tax assessment records, if available, and if not, a visual survey of houses/property), b) distribution of income based on estimates for different jobs as associated with data from occupation structure of the community, c) census data on educational and income levels, d) archival data on zoning/land use patterns and plans, including comprehensive community planning documents
28. Power structure	People, public and private organizations and institutions who have influence or authority within the place-based and activity communities		1) Sample survey of perceptions; triangulated key informant interviews and network analyses re. informal power structure, 2) archival data on formal power structure (e.g. news media, official town documents); observational studies (informal power structure)
29. Occupational structure	Occupational structure of place-based and activity communities		1) Sample survey of employment history (e.g. occupations held, reasons for entry and exit, levels of remuneration); triangulated key informant interviews; 2) employment by sector and subsector from town records, Chamber of Commerce, local office of employment security, official license/port/harbor data
30. Income/benefit	Proportion of income from activity, and/or proportion of activity-related product in diet (Note: Benefit in this context is defined as subsistence use of activity-related products.)		1) Sample survey of households on income, employment and other benefits (e.g. role of activity in diet and nonmonetary transfers) from the activity; 2) gross community product by sector and subsector from tax data, utilities, gross receipts, etc.; 3) use of resource in prestige rankings, establishing and reinforcing familial/extra familial social networks; 4) use of resource in redistribution systems
31. Dependence	Level of dependence of place-based community, households and families on the activity [Note: A current working NMFS definition is: Dependence is a measure of the level of participation in a fishery relative to other community activities, and relative to all other communities linked to fishing in some way (Norman et al. <sup>3</sup> )].		Archival data, databases (see indicators listed in Norman et al. <sup>3</sup> )
32. Engagement	Level of engagement of place-based community, households and families on the activity [Note: A current working NMFS definition is: Engagement is a measure of the level of participation relative to the overall level of participation in a fishery (Norman et al. <sup>3</sup> )]		Archival data, databases (see indicators listed in Norman et al. <sup>3</sup> ).
33. Community solidarity	Levels of solidarity in place-based and activity communities		1) Sample survey (including questions on strength of networks, sociopolitical voice, cultural homogeneity/heterogeneity, kinship ties, connectivity between migrants, definition and sense of community, social capital, participation in expressive culture including events such as blessing of the fleet and fishing tournaments); network analysis; 2) number of cooperative organizations, churches, social organizations, etc. and their membership; network density (connectivity measure), observed participation in expressive culture including events such as blessing of the fleet and fishing tournaments; public presence of material culture such as sculptures, pictures, or other memorabilia celebrating the community
34. Physical health-community	Physical health condition of place-based and activity communities		Community physical health survey; prevalence and incidence rates from public health records (local, county, state, CDC) on infant deaths, number childhood immunizations, health of workforce, etc.
35. Mental health-community	Mental health condition of place-based and activity communities		Prevalence and incidence rates from public health records (e.g. state, county, local databases, CDC) of stress-related disorders and treatment (e.g. depression, stress, drinking, psychosomatic illnesses, anxiety, self-esteem issues, psychiatric care and counseling); sample surveys on community mental health; triangulated key interviews with local healthcare professionals
36. Cultural heritage and norms/values	The role of activity and marine environment in history, spirituality, self-representation/identity, and knowledge production		1) Sample surveys including perception of activity importance to community, beliefs about marine ecosystems, atti-

*continued*

**Appendix Table 1.—(continued) SIA model variables.**

Construct group	Constructs	Variables <sup>1</sup>	Suggested measurement strategies
	37. Resilience-community	Capability of coping successfully (resilience) in face of significant adversity or risk in place-based and activity-based communities, families, and households	<p>tudes toward marine ecosystems, environmental attitudes, cultural importance of marine ecosystems; triangulated key informant interviews on traditional ecological knowledge and local activity knowledge (e.g. local fisheries knowledge) and religious/spiritual beliefs/institutions; 2) archival data (e.g. newspapers, Chamber of Commerce information, environmental historical documents, iconography)</p> <p>1) Place-based community index based on items such as job diversity; distance to county seat; distance to state highway; distance to interstate highway; distance to regional center for retail shopping, medical care, and financial services; cultural commonality/ethnic homogeneity; number of associations and organizations; number of members in associations and organizations; perceptions of leadership quality/proactive orientation; community attractiveness; evidence of past adaptations to nonlocal change affecting community; 2) activity-based community index based on items such as no. of activity-related businesses, support industries and associations; no. of members in associations; level of recruitment of activity participants; trends in activity-related resource levels and regulations/restrictions on access to these resources; cost of entry; no. of permits per vessel for commercial fishing</p>
Social problems	38. Social problems	Social problems in place-based and activity communities and families	<p>1) Sample survey/structured interviews/triangulated key informant interviews (including social workers, police, etc.); 2) public statistics (local, county, state, CDC) including spouse abuse incidents, crime incidents, alcohol abuse counts, drug abuse counts, poverty rate, number of children on reduced price lunches at schools, literacy, oral fluency in English, unemployment rates; archival data from local newspapers</p>
	39. Conflict	Level of conflict in place-based and activity communities (both within and between groups) and in families	<p>1) Sample surveys/structured interviews/triangulated key informant interviews, 2) police reports, news media, court cases filed, agendas from town board meetings</p>
	40. Regulatory non-compliance	Levels/types of noncompliance with activity regulations, whether formal or informal, in place-based and activity communities	<p>1) Sample survey/structured interviews/triangulated key informant interviews of individual reports and/or perceptions (including questions about behaviors of others); 2) archival data (e.g. review fisheries law enforcement reports and news media; numbers of citations and infractions, normalized for non-uniform levels of enforcement coverage; creel survey reports)</p>
Well-being attributes	41. Index of well-being	Levels of well-being in place-based and activity based communities, families, and individuals	<p>1) Sample survey of perceptions/self-reports including a) happiness (individual, familial, and communal), b) empowerment, c) self-esteem, d) satisfaction with aspects of living conditions, e) satisfaction with relationships (familial, communal), etc.; 2) Quantitative indicators of the change in objectively measured well-being index (e.g. Human Development Index, Index of Social Well-being, Canadian Well-Being Index, Oregon Progress Indicators) and/or distributions for variables such as community, family, or individual living conditions, stature, wealth, or power</p>

<sup>1</sup> Get temporal comparative data 1980 to present where possible.

<sup>2</sup> Driver, B. L. 1983. Master list of items for recreation experience preference scales and domains. USDA For. Serv. Rocky Mt. For. And Range Exp. Sta., Ft. Collins, Colo. Unpubl. Doc., 10 p. Online at <http://wilderdom.com/html/DriverREPScales.doc>, accessed 1 May 2007.

<sup>3</sup> Norman, K., J. Sepez, H. Lazarus, N. Milne, C. Package, S. Russell, K. Grant, R. Petersen, J. Primo, E. Springer, M. Styles, B. Tilt, and I. Vaccaro. 2006. Community profiles for West Coast and North Pacific fisheries—Washington, Oregon, California, and other U.S. states. NMFS-NWFSC, NOAA, 625 p. Online at [http://www.nwfsc.noaa.gov/research/divisions/sd/communityprofiles/Supplemental\\_Community\\_Profiling\\_Document\\_DRAFT.pdf](http://www.nwfsc.noaa.gov/research/divisions/sd/communityprofiles/Supplemental_Community_Profiling_Document_DRAFT.pdf), accessed 6 May 2007.